Suspended-Patch Antenna With Inverted, EM-Coupled Feed

This design offers advantages with respect to efficiency, fabrication, cost, and weight.

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An improved suspended-patch antenna has been designed to operate at a frequency of about 23 GHz with linear polarization and to be one of four identical antennas in a rectangular array. The antenna (see Figure 1) includes a parasitic patch on top of a suspended dielectric superstrate, an active patch on top of a suspended dielectric substrate, a microstrip on the bottom of the dielectric substrate, and a ground plane. The microstrip, the ground plane, the airgap between them, and the dielectric substrate together constitute a transmission line that has an impedance of 50 Ω and is electromagnetically (EM) coupled to the active patch. The parasitic patch is, in turn, excited by the active patch. The microstrip feed is characterized as inverted because the microstrip is on the bottom of the substrate, whereas microstrips are usually placed on the tops of dielectric substrates.

The advantages of this design are the following:

- The attenuation in the inverted microstrip feed is less than that of a conventional microstrip feed; hence, the conductor loss associated with the corporate feed of the antenna is correspondingly lower and the gain and efficiency of the antenna are correspondingly higher.
- Relative to a conventional microstrip feed, the inverted microstrip feed can be fabricated more easily because the strip width for a given characteristic impedance is greater.
- Whereas a conventional EM-coupled patch antenna includes a dielectric substrate for the microstrip feed and another suspended dielectric layer for the active patch, one dielectric substrate supports both the microstrip and the active patch in this antenna. The elimination of the additional suspended dielectric layer reduces the weight and cost of the antenna.
- The electromagnetic coupling affords greater bandwidth than does conductive coupling.

Figure 2 presents measurements performed on the four-antenna array. The return-loss plot shows that the array is very well matched to the 50-Ω feed lines. The relative bandwidth for return loss ≤–10 dB is about 5.4 percent. The array was found to radiate with substantially linear polarization. The measured gain of the array, as compared with that of a standard gain horn antenna, is estimated to be about 10 dB.

This work was done by Rainee N. Simons of Dynacs Engineering Co. for **Glenn Research Center**. *Further information is contained in a TSP (see page 1).*

Inquiries concerning rights for the commercial use of this invention should be addressed to: NASA Glenn Research Center, Commercial Technology Office, Attn: Steve Fedor, Mail Stop 4–8, 21000 Brookpark Road, Cleveland, Ohio 44135.

Refer to LEW-17354.

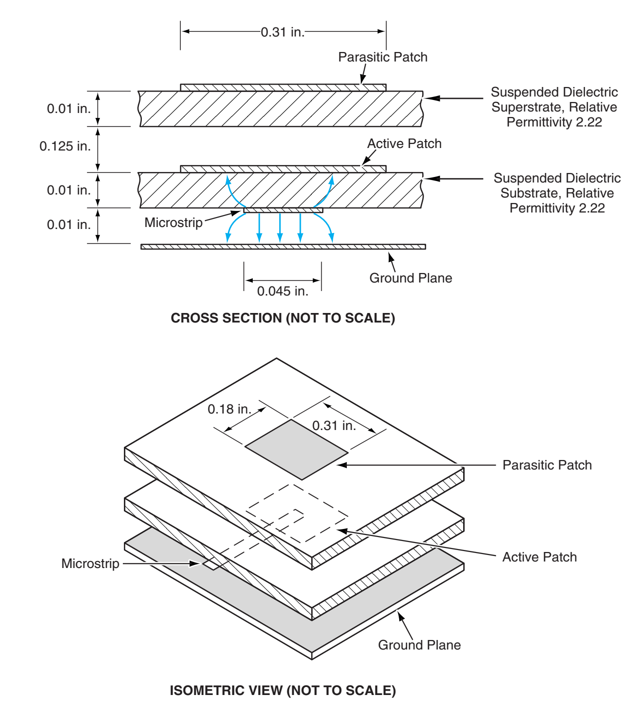

Figure 1. The **Dielectric and Conductive Layers** in this antenna are arranged to reduce losses, relative to comparable prior patch antennas that include EM-coupled elements. The dimensions shown are for a design frequency of ≈23 GHz.

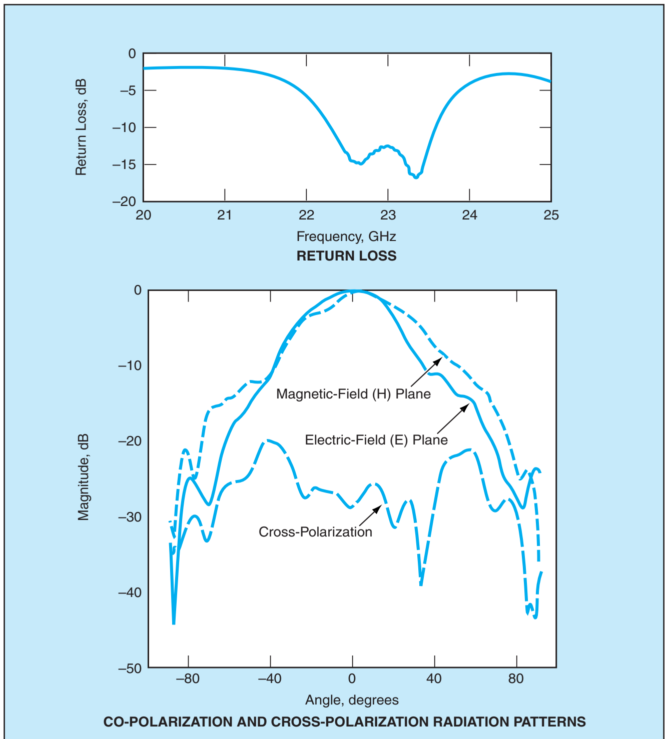

Figure 2. **Return Loss and Radiation Patterns** were measured for a rectangular array of four antennas like that of Figure 1.